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# TTI 1200

# TTI 1200

# PHASE JITTER TEST SET

# AND HIT MONITOR

# INTERIM OPERATING INSTRUCTIONS

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# TTI 1200 Phase Jitter Test Set

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# TTI 1200

# PHASE JITTER TEST SET

# AND HIT MONITOR

# INTERIM OPERATING INSTRUCTIONS

## 1. GENERAL

1.01 This document describes the TTI 1200 Phase Jitter Test Set and Hit Monitor and the procedures to be followed in using the instrument. Also included is information on TTI's warranty and factory repair service.

1.02 The TTI 1200 Phase Jitter Test Set measures phase jitter at the voice-frequency points on transmission facilities. The instrument receives a test tone from the far end and provides a digital display of the phase jitter on the test tone. The measurement range is from 00.0 degrees to 99.9 degrees (an over-range indicator is included). The Test Set automatically phase locks to the test tone frequency. Thus, no manual adjustments are necessary for either level or phase lock.

1.03 The Test Set incorporates three operating modes. One mode provides measurement correlation with other phase jitter measuring instruments. The other two modes provide a unique capability for measuring higher-frequency jitter components that cannot be measured by other instruments. These three operating modes are explained in detail in Section 2.

1.04 The Test Set is a portable instrument which operates from 115-volt or 230-volt AC power (switch selectable). The only required connection beside the power is the signal input. This may be provided through a standard 310 jack on the front panel or through binding posts on the rear panel. The instrument also has facilities for providing an analog output of the jitter to an oscilloscope, a spectrum analyzer, or other display device. This analog output is available through a 310 jack on the front panel and through binding posts on the rear panel.

1.05 Optional rack-mounting hardware is available to mount the Test Set in either a 19-inch or a 23-inch rack. Rack mounting does not change the operation of the instrument in any way.

1.06 The TTI 1200 may be equipped with an optional Hit Monitor to count phase hits, gain hits, and dropouts. Adjustments include phase hit threshold (in degrees), gain hit threshold (in dB), and dropout duration (in milliseconds). The Hit Monitor uses an electronic timer that may be set to count for 5 minutes, 15 minutes, or continuously (up to 999 minutes). The Hit Monitor draws both its power and its input signal from the Phase Jitter Test Set. Thus, it requires no external connections.

## 2. OPERATING CONTROLS, INDICATORS, AND JACKS

### Front Panel--Phase Jitter Test Set

2.01 The following operating controls, indicators, and jacks appear on the front panel of the Phase Jitter Test Set. They are listed here from left to right and from top to bottom.

a. Power. This is a push-button switch that turns the instrument on and off. An indicator light, located above the switch, is illuminated when the power is on.

b. Digital display. Three Nixie tubes in the digital display provide a direct readout of phase jitter to a resolution of 0.1 degree. The display is automatically blanked when the incoming signal is outside the proper level range (-40 to +10 dBm) or when the instrument is not phase locked to the incoming signal frequency. The display is also blanked under certain conditions in the P-P FLT IN operating mode (see "c" below). A decimal point on the left side of the display acts as an over-range indicator. This decimal point lights to indicate any measurement over 99.9 degrees.

c. Mode. This three-position switch (not labeled on the panel) selects any one of three operating modes. The operation in these modes is as follows:
P-P FLT IN. This mode provides measurement correlation with other phase jitter measuring instruments. In this mode, the instrument requires a test tone frequency of 1020 Hz $\pm$ 40 Hz. If the frequency is outside this range, the display is automatically blanked. (For the engineer interested in the details of the instrument, it should be pointed out that the input filtering of the instrument in this mode passes any frequency between 300 Hz and 1800 Hz. The measurement circuitry continues to operate for any test tone within this range, even though the display may be blanked. In such a case, the phase jitter information is available at the analog output.) In the

P-P FLT IN mode, the Test Set measures only phase jitter components between 20 Hz and 300 Hz. Any components outside this range are filtered out. In this mode, the display indicates peak-to-peak total phase jitter.
P-P FLT OUT. This mode also measures peak-to-peak total phase jitter, but the input lowpass filter and the phase detector output filter are removed. The Test Set accepts and measures the phase jitter on any tone from 500 Hz to 3 kHz. The display then indicates all phase jitter components from 20 Hz up to the frequency of the test tone.
PEAK/CYCLE. In this switch position, the Test Set provides readings of peak per-cycle phase jitter. This measurement mode is particularly sensitive to high-frequency jitter components (such high-frequency components are de-emphasized by the peak-to-peak total jitter measurement). In the PEAK/CYCLE mode, the Test Set accepts any test tone frequency from 500 Hz to 3 kHz. The display indicates any phase jitter components from 20 Hz up to the test tone frequency.

d. Impedance. Two push-button switches provide for the selection of either 600-ohm or 900-ohm input impedance. Since the selection of input impedance simply ensures that the Test Set presents the proper impedance for the test circuit, impedance selection is not normally critical unless the level of the test tone is near the extremes of the Test Set's range.

e. Damping. Two push-button switches select the degree of damping in the reading shown on the display. When the instrument is set for LO damping, the display indicates the phase jitter averaged over a period of 0.1 second. When HI damping is selected, the display indicates the phase jitter averaged over a period of 1.0 second. HI damping is normally used only when jitter readings fluctuate widely and rapidly.

f. Input. This 310 jack accepts the incoming test tone from the far end of the transmission facility.

g. Input monitor. This indicator lamp lights whenever the incoming test tone is below -40 dBm. The digital display also blanks in such a case. If the input monitor lamp goes out, but the display is blank, the probable cause is a high noise input. Such a condition could raise the input level above -40 dBm without providing a signal for the phase-lock loop to lock to.

Rear Panel--Phase Jitter Test Set

2.02 The following connections and switch appear on the rear panel of the Phase Jitter Test Set:

a. Power cable. The power cable is for connection to single-phase AC power, either 115 or 230 volts (± 10%).

b. Power switch. The power switch selects 115 or 230 volt operation. THIS SWITCH MUST BE SET FOR THE VOLTAGE TO BE USED BEFORE THE TEST SET IS PLUGGED IN.

c. Signal input. These terminals are in parallel with the "input" jack on the front panel. They may be used instead of the jack to accept the incoming test tone.

d. Analog output. These terminals may be used to provide an analog output of the phase jitter being measured to a display device such as an oscilloscope or a spectrum analyzer.

Front Panel--Hit Monitor

2.03 The following controls, switches, and indicator appear on the front panel of the Hit Monitor.

a. Start/Reset. This switch starts and resets the timer, which controls the interval over which the various events are counted.

b. Digital display. The three-digit display indicates the number of minutes the timer has been running, the number of phase hits counted, the number of gain hits counted, or the number of dropouts counted, depending on the setting of the associated function switch.

c. Function switch. This four-position switch (not labeled "function" on the panel) controls the function that appears on the digital display. These are as follows:
TIME-MIN. When the switch is in this position, the display indicates the number of minutes the timer has been running (in other words, the number of minutes the counter has been counting phase hits, gain hits, and dropouts).
PHASE HIT. When the switch is in this position, the display indicates the number of phase hits that have been counted during the timing interval.

GAIN HIT. When the switch is in this position, the display indicates the number of gain hits that have been counted during the timing interval.

DROPOUT. When the switch is in this position, the display indicates the number of dropouts that have been counted during the timing interval.

Note: Since the various events are stored in separate registers, the function switch may be changed at any time without destroying the count. The counter starts again only when the Start/Reset switch is pushed.

d. Timer. This three-position switch controls the timing interval during which the counter counts phase hits, gain hits, and dropouts. The counter may be set to run for 5 minutes, 15 minutes, or continuously (up to 999 minutes). The counter stops automatically when it completes the timing interval for which it is set. The Start/Reset switch must be pushed before the timer will begin operating again.

e. Phase Hit. This nine-position switch sets the phase hit counting threshold in 5-degree steps from 5 to 45 degrees.

f. Gain Hit. This five-position switch sets the gain hit counting threshold for $\pm 1$, $\pm 2$, $\pm 3$, $\pm 6$, or +10 dB.

g. Dropout. This six-position switch sets the minimum duration of the dropouts that will be counted. It can be set for 1, 3, 10, 30, 100, or 300 milliseconds.

Rear Panel--Hit Monitor

2.04 Output connections for phase hits, gain hits, and dropouts are provided on the rear panel of the Hit Monitor. They can be used to connect an external counter, a strip-chart recorder, or other display device. These connections provide a pulse which is slightly shorter than the particular event being counted. This slight delay in starting the output pulse is caused by the time necessary to detect the event and to distinguish it from another type of event. The delay times are as follows:

| | |
|---|---|
| Phase hit: | 1.4 millisecond |
| Gain hit: | 3 milliseconds (approximately) |
| Dropout: | 1 millisecond |

## 3. OPERATION

Connecting the Test Set

3.01 Connect the Test Set as follows:

a. Set the power switch on the rear panel for the voltage to be used to power the instrument--either 115 or 230 volts AC.

b. Plug the power cord in.

c. Push the power switch on the front panel. At this point, with no input signal applied, the "input monitor" and "power" lamps should light, and the digital display should be blank.

d. Apply an incoming test tone to the "input" jack on the front panel or to the "signal input" terminals on the rear panel (do not use both the jack and the terminals simultaneously).

e. If the analog output is to be monitored on another display device, use the "analog output" terminals on the rear panel to provide the signal to the other device.

Phase Jitter Tests

3.02 Once the Test Set is properly connected, the phase jitter measurement can be read directly from the digital display on the front panel of the instrument. The operating mode selected may depend on the type of reading desired. For example, to obtain a measurement that correlates with those made on other phase jitter measuring instruments, select the P-P FLT IN mode. However, it should be recognized that in this mode the Test Set accepts only a test tone frequency of 1020 Hz $\pm$ 40 Hz. Furthermore, this mode cannot measure jitter components above 300 Hz.

3.03 If a test tone other than 1020 is to be used, select first the P-P FLT OUT mode. This mode measures all the jitter components that can be measured in the P-P FLT IN mode, and it can "see" higher frequency components (even though the higher frequency components are somewhat de-emphasized in the mode due to the measuring technique). To check for predominantly high-frequency jitter components, change to the PEAK/CYCLE mode. If the phase jitter reading increases, high-frequency components are present.

3.04 Much information about the nature of the phase jitter can be gained by observing the differences in readings in the three operating modes. For example, if both the P-P FLT IN and the P-P FLT OUT modes show high readings, while the PEAK/CYCLE mode shows a low reading, the jitter components are primarily low frequency (below 300 Hz). Table A summarizes this and other possible cases.

| P-P FLT IN Reading | P-P FLT OUT Reading | PEAK/CYCLE Reading | Primary Jitter Components (Frequency Range) |
|---|---|---|---|
| low | high | high | above 300 Hz |
| high | high | low | below 300 Hz |
| high | high | high | broadband |

Table A. Comparison of Operating Modes

3.05 Since phase jitter measurements are normally made in connection with data transmission, it is often convenient to use a modem as a test tone source. If there is a modem at the far end of the transmission facility, it may be possible merely to command it to transmit a continuous MARK or a continuous SPACE frequency. Often this can be done remotely, eliminating the need for any personnel at the far end. In any case, using a test tone of the same frequency that the modem uses will assure that the phase jitter reading correlates with the circuit conditions actually encountered by the modem. This is particularly important for measurements made on transmission facilities that include PCM carrier. On PCM carrier, both the magnitude and the frequency of the jitter components may vary widely as a function of the test tone frequency used. Therefore, measurements that are not made at the modem's operating frequencies may not correlate with the phase jitter actually encountered by the modem.

## Counting Phase Hits, Gain Hits, and Dropouts

3.06 Since the Hit Monitor receives both signal input and power from the Phase Jitter Test Set, no external connections to the Hit Monitor are necessary. To use the Hit Monitor, proceed as follows:

a. Set the Phase Jitter Test Set to either the P-P FLT IN or the P-P FLT OUT mode. Do not use the PEAK/CYCLE mode for hit monitoring.

   Note: Changing either the Mode switch or the Impedance switch on the Phase Jitter Test Set while hit monitoring is in progress will introduce spurious hits, invalidating the count.

b. Set the Timer switch for the desired counting interval.

c. Set the Phase Hit, Gain Hit, and Dropout switches for the desired thresholds and duration.

d. The position of the function switch does not affect the counting process. This switch may be used to read the elapsed time, the phase hit count, the gain hit count, or the dropout count at any time during or after the counting interval.

e. To erase the storage and start a new count, push the Start/Reset switch.

## 4. SPECIFICATIONS

### Phase Jitter Test Set (List 1)

Input Characteristics

| | |
|---|---|
| Test | 500 Hz to 3 kHz. (1020 Hz ± 40 Hz in P-P FLT IN mode). |
| Level | -40 dBm to +10 dBm. |
| Impedance | 600 or 900 ohms, balanced, switch selectable. |
| Balance | 40 dB. |

| | |
|---|---|
| Protection | DC input: Blocks 300 volts.<br>Spikes: Withstands 600 volts for 3 µsec, either terminal to ground.<br>Longitudinal Voltage: 30 volts rms.<br>Metallic Voltage: 50 volts rms. |
| Terminal | 310 jack on front panel.<br>Terminal strip on rear panel. |
| Measurement Modes | a. Total phase jitter--filtered peak to peak.<br>b. Total phase jitter--unfiltered peak to peak.<br>c. Per-cycle phase jitter--peak. |
| Jitter Frequency Range | 20 Hz to 3 kHz, subject to these restrictions:<br>a. Test frequency;<br>b. Bandwidth of test circuit;<br>c. Measurements in the P-P FLT IN mode are restricted to 20 - 300 Hz. |
| Display | Digital, 3 Nixie tubes, with over-range indicator. |
| Range | 00.0 to 99.9 degrees. |
| Resolution | 0.1 degree. |
| Accuracy | ±2% of reading ±0.2 degree. |
| Analog Output | |
| Connection | Terminal strip on rear panel. |
| Level | 1 volt = 10° ±10%. |
| Source Impedance | 10,000 ohms. |
| Power Requirement | 115/230 volts ±10% AC.<br>45 to 400 Hz.<br>200 ma. |

| | |
|---|---|
| Size | Height: 5-1/4 inches.<br>Width: 7-3/4 inches.<br>Depth: 11-1/4 inches. |
| Weight | 9-1/2 pounds. |
| Operating Temperature Range | 0° to 50°C. |

SPECIFICATIONS

Hit Monitor (List 2)

| | |
|---|---|
| Input | Utilizes signal input from List 1 Phase Jitter Test Set (internally connected). |
| Phase Hit Counter | |
| Threshold, event magnitude | ±5° to ±45° peak in 5° increments. |
| Threshold, event duration | 0.1, 1.4, or 4.0 ms ±5% (Rear panel switch selectable). |
| Maximum counting rate | 7 counts/second (143 ms delay between sequential counts). |
| Dropout Counter | |
| Threshold, event magnitude | -18 dB. |
| Threshold, event duration | 1, 3, 10, 30, 100 and 300 ms. |
| Maximum counting rate | 7 counts/second (143 ms delay between sequential counts). |
| Timer | |
| Counting period | 5 min., 15 min., and continuous. |
| Counter capacity | 999 counts. |
| Resolution | 1 minute. |
| Display | 3 digits (Nixie). |
| Analog Outputs | |
| Terminal | Terminal strip on rear panel. |
| Source impedance | 130 ohms. |
| Output level | 4-volt positive-going pulses into load impedance of 10,000 ohms or greater. |

| | |
|---|---|
| Phase and Gain Hit | Single pulse output for each event exceeding respective threshold setting and having a duration exceeding 0.1, 1.4, or 4.0 ms, dependent upon rear panel switch selection. Pulse duration equal to event duration less 1.4 ms or 4.0 ms. |
| Dropout | Single pulse output for each dropout exceeding the -18 dB threshold irrespective of event duration threshold setting. Pulse duration equal to event duration less 0.6 ms. |
| Power Requirement | Obtained from List 1 Phase JItter Test Set (internally connected). |
| Size | Height: 5-1/4 inches<br>Width: 7-3/4 inches<br>Depth: 11-1/4 inches |
| Weight | 17 pounds (List 1 - List 2 combination) |

## WARRANTY

TTI warrants instruments manufactured by it to be free from defects in material and workmanship under normal use and service within specified ratings and operating conditions. Our obligation under this Warranty is limited to the repair or replacement, at TTI's sole discretion, of any instrument or part thereof which, when returned to TTI within one year of original shipment and upon our examination proves to be thus defective. This warranty includes the cost of return surface transportation from the factory. It does not include the cost of transportation to the factory and/or the cost of packaging the instrument for return to the factory, unless such instrument is returned within 30 days from the date of original shipment and prior written authorization for the reimbursement of such cost is obtained from the factory.

This Warranty shall not apply to any instrument which has been (1) repaired, worked on, or altered by persons not authorized by TTI so as, in TTI's sole judgement, to injure the stability, reliability, or proper operation of such instrument; (2) subjected to misuse, negligence, or accident; and (3) connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by TTI. Accessories, including, but not limited to, fuses and batteries, not of TTI's manufacture, used or installed with this instrument are not covered by this Warranty.

TTI reserves the right to make changes in the design or construction of its instruments at any time without incurring any obligation to make these changes in instruments previously sold and delivered.

The repair or replacement of any part or parts of an instrument under this agreement does not void or extend the original Warranty period for the whole instrument. Repaired or replaced parts are warranted for the remainder of the instrument warranty period or for 90 days from the date of repair, whichever shall be longer.

We are not liable for consequential or incidental damages. This Warranty is in lieu of all others expressed or implied and no representative or person is authorized to assume for us any other obligations or liabilities in connection with the sale of TTI instruments and products.

## FACTORY REPAIR SERVICE

TTI maintains a complete facility to repair any TTI instrument, whether or not the necessary repair is covered by the warranty.

### Malfunction Report

Any instrument returned to the factory for repair, whether covered by warranty or not, should be accompanied by the malfunction report (the following page of this manual). This report should be completed in as much detail as possible to assure quick and complete correction at the factory.

### Shipping Instructions

Make sure the instrument is adequately packed to prevent damage in transit. TTI will not be responsible for such damage. If possible, the instrument should be returned in its original shipping container. If this is not possible, use a shipping container that allows for at least four inches of high-quality packing material on every side of the instrument.

Ship the instrument prepaid to

Telecommunications Technology, Inc.
555 Del Rey
Sunnyvale, California 94086

The tear-out shipping label on the malfunction report may be used.

### Charges

The warranty does not cover shipping charges to the TTI factory. However, if the instrument is in warranty, TTI will pay the cost of surface shipment from the factory.

If the instrument is not in warranty, TTI will bill for the repair at normal rates. Shipping costs will be billed at TTI's cost.

In the event of malfunction, please complete this report and return it in the shipping container with the instrument. A shipping label is attached for your convenience.

Company_____
Dept_____
Address_____
_____
Instrument Model # _____
Serial # _____
TTI Shipping Date_____

From_____
_____
_____

To: Telecommunications Technology, Inc.
555 Del Rey
Sunnyvale, California 94086

(Shipping date appears on last page of instruction manual. Warranty expires one year from this date.)

☐ Please furnish estimate before proceeding with repair.

## DETAILED DESCRIPTION OF MALFUNCTION

Signature_____
Title_____

Instrument serial number 263/225

TTI Shipping date

# TTI
# MODEL 1200 PHASE JITTER TEST SET
# DESCRIPTION

## 1. GENERAL

1.01 This Section provides a general description of the Telecommunications Technology, Inc. (TTI) Model 1200 Phase Jitter Test Set.

1.02 The Model 1200 is used to measure phase jitter in voice frequency transmission facilities, both FDM and TDM systems.

1.03 Complete description and operational procedures may be found in the manual supplied with each instrument. Additional copies of the manual may be obtained from:

Telecommunications Technology, Inc.
920 Commercial Street
Palo Alto, California 94303

## 2. DESCRIPTION

2.01 Phase jitter is defined as undesired, angle modulation imparted to a signal being transmitted over a communications circuit. It may be in the form of frequency modulation, phase modulation, or both. The test set is primarily digital: a three digit display provides readings directly in degrees. The reading range is from 00.0° to 99.9°. An over-range lamp lights to indicate readings in excess of 99.9°.

2.02 The Model 1200 reads jitter rate components from 400 Hz to 3 kHz and accepts test tones from —40 dBm to +10 dBm.

2.03 The instrument operates in three switch-selectable modes: per-cycle peak phase jitter, total peak-to-peak phase jitter (unfiltered) and total peak-to-peak phase jitter (filtered).

2.04 The Model 1200 has automatic frequency tracking over its total frequency range, with no manual adjustments. When the input signal is not within the positive lock-in frequency range, or when the signal-to-noise ratio is too low for a valid reading, the digital display is automatically blanked.

2.05 Resolution of the display is 0.1%; accuracy is ±2% of reading (±0.2°).

2.06 The test set operates from an ac power source of 115V to 230V (±10%), 45 Hz to 400 Hz. Power consumption is 200 mA. Useful operating temperatures range from 32°F to 122°F.

2.07 Dimensions of the Model 1200 are as follows: height, 5-1/4 inches; width, 7-3/4 inches; depth, 11-1/4 inches. The instrument weighs 9-1/2 pounds.

2.08 An optional Hit Monitor (GTE Standard) combines mechanically with the basic instrument to form a single, double-width package. The Hit Monitor draws both its input signal and power from the Model 1200. The monitor counts phase hits, gain hits and dropouts; the three types of events are stored in separate registers. A selector switch permits them to be read out independently on the digital display without destroying the count.

April 1971

# TTI 1200

## PHASE JITTER TEST SET

The TTI 1200 Phase Jitter Test Set represents a significant advance in the measurement of phase jitter on voice-frequency transmission facilities. It has several unique design innovations that make it easy to use, versatile, and essentially error-proof.

The most important of these innovations is a new basic measurement technique. It enables the Test Set to measure high-frequency jitter components that cannot be measured by conventional phase-detection methods. However, the Test Set can also make low-frequency band-limited measurements to provide correlation with other instruments. The key features of the TTI 1200 are:

Wide Test Frequency Range. The Test Set uses any test frequency from 300 Hz to 3 kHz.

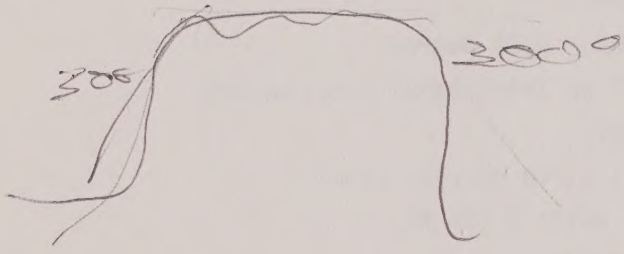
Measures All Jitter Rate Components. Special phase detector means no output filtering is needed.

No Operating Adjustments. Automatic phase lock and input limiting over the entire frequency and level ranges permit "plug-in-and-read" operation.

Digital Readout. The three-digit Nixie display gives a direct numerical readout from 00.0° to 99.9°.

Large Dynamic Range. The instrument accepts test tones from -40 dBm to +10 dBm.

Telecommunications Technology, Inc. / 920 Commercial Street, Palo Alto, Calif. 94303 / (415) 326-9217

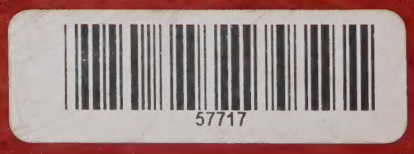

3000

ACCOPRESS®

| | |
|---|---|
| 25970 | YELLOW |
| 25971 | BLACK |
| 25972 | LIGHT BLUE |
| 25973 | DARK BLUE |
| 25974 | LIGHT GRAY |
| 25975 | LIGHT GREEN |
| 25976 | DARK GREEN |
| 25977 | TANGERINE |
| 25978 | RED |
| 25979 | EXECUTIVE RED |

GENUINE PRESSBOARD

ACCO USA, INC.
770 S. ACCO PLAZA
WHEELING, IL 60090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